

SYNOPSIS OF *KOCHIA* (CHENOPODIACEAE) IN NORTH AMERICA

WILL H. BLACKWELL, JR., MARK D. BAECHLE, AND
GENE WILLIAMSON

*Herbarium, Department of Botany, Miami University
Oxford, Ohio 45056*

ABSTRACT

Kochia in North America as revised includes three species, two native and one introduced. A historical summary of work on the genus in North America is presented, and typification, distribution, and systematics of the species are discussed. Specimens from each county recorded are cited for the native species.

As with most genera of Chenopodiaceae in North America, *Kochia* has long been neglected taxonomically and has become a persistent source of error. Not only are misidentifications frequent in herbaria, but doubt has continued to exist as to the number of taxa that should be recognized, the rank they should be assigned, and the distributional pattern they exhibit; nomenclatural questions also exist. It is toward solution of these problems that the present study is directed.

Kochia was described by Roth in 1800 based on a single European species, *K. arenaria* (= *K. laniflora*, cf. *Flora Europaea* 1: 99). Since 1800, additions to the genus have been substantial; Airy Shaw (1973) provides the recent estimate of 90 species, these occurring primarily in Europe, Asia, and Australia. The complement of species found in North America is small, and consists of both native and introduced elements.

Kochia first received serious taxonomic attention in North America in 1874 when Watson described two taxa: *K. americana* [var. *americana*] and *K. americana* var. *vestita*. Later (1882), Watson described a second native species, *K. californica*. In 1906, Rydberg added yet another by elevating Watson's var. *vestita* to the level of species without explanation. The next milestone for the genus in North America was Standley's revision (1916), incorporated in his treatment of the Chenopodiaceae in *North American Flora*. Standley recognized four species: *K. americana*, *K. vestita*, *K. californica*, and the introduced *K. scoparia*; he recognized no varieties.

Most floristic treatments of *Kochia* in the United States have accepted the conclusions of Standley's revision. A few exceptions are apparent, however. Weber (1972), in his *Rocky Mountain Flora*, suggested that *K. iranica* Bornmueller is a conspicuous component of the Colorado flora and that it has been confused with *K. scoparia*. However, we have studied one of Weber's collections, Weber 12991 (GH, UC), of "*iranica*" and find it to be

merely another specimen of *K. scoparia*. In fact, no specimens identifiable as *K. iranica* turned up in any of the North American collections we examined. It is thus our conclusion that *K. iranica* is not a part of the flora of the United States. *Kochia hirsuta* Nolte, reported by Davis (1952) as introduced in Idaho, is probably not a *Kochia*. The short-conic tubercles or spines of the calyx indicate that it is more likely *Bassia*. We have examined the type of *Kochia alata* Bates; it is just another specimen of *K. scoparia*. The varieties of *K. scoparia* recognized by Steyermark (1963) seem unwarranted as intergradation between them is continuous and geographic pattern lacking.

Although several genera of Chenopodiaceae in North America have a similar appearance, we encountered the greatest difficulty, particularly at the outset, distinguishing *Kochia* from *Suaeda*. However, we now know that several characteristics are reliable. The embryo of *Kochia* is annular and usually associated with endosperm; *Suaeda*'s embryo is spirally coiled, the endosperm lacking. In the absence of good embryos, distinction can still be made. *Suaeda* has three scarious bracts subtending each axillary flower or flower group, these in turn subtended by a leaf or larger herbaceous bract; in *Kochia*, scarious bracts are lacking. *Kochia* stems (native species) are generally floriferous or potentially so throughout their length; in *Suaeda*, the flowers are usually restricted to distal inflorescences of various sorts. The calyx of *Kochia* is cleft no more than half way to the base, while that of *Suaeda* is cleft nearly to the base. Finally, in *Kochia* distinct transverse wings develop on the back of the calyx lobes in fruit, a feature usually (though not always) lacking in *Suaeda*. Number of flowers per leaf axil and alternate vs. opposite leaves (Davis, 1952), will not provide separation between these genera. The number of flowers per leaf axil in *Kochia* is 1-3(-5) and in *Suaeda* is 1-3(-9). In both genera the leaves are typically alternate. We acknowledge Mrs. Christine O. Hopkins for her assistance in distinguishing these two genera.

To determine the number of taxa of *Kochia* occurring in North America (including introduced, naturalized taxa), the rank they should be assigned, their distribution, and their typification, North American specimens were studied from the following herbaria: A, F, GH, MO, MU, TEX, UC, US, and UT. For comparison, Old World specimens were examined from MU, TEX, UC, and UT. Australian collections were borrowed from MO and US. We acknowledge the curators of these herbaria for their cooperation in loaning *Kochia* specimens. In the species treatments, based on our herbarium and literature study, only those synonyms causing confusion in North America are listed, in addition to basionyms.

GENERIC DESCRIPTION

Annuals, perennial herbs (often woody at the base), or subshrubs. Leaves mostly alternate, flat or terete, sessile or petiolate. Flowers small, sessile, 1-5 per axil, bisexual or unisexual (native U.S. species often polygamous),

in terminal leafy spikes or the entire branches floriferous; scarious bracts lacking; calyx 5-lobed, cleft not more than half way to the base, developing dorsal, horizontal, membranous wings in fruit; corolla lacking; stamens 5, usually exserted; stigmas 2 or 3. Utricle depressed-globose, closely surrounding but not attached to the seed, eventually disintegrating. Seed horizontal and occupying most of the space within the utricle, remaining more or less enclosed in the calyx; embryo annular around the scanty to copious endosperm.

SPECIES OF *KOCHIA* IN NORTH AMERICA

- A. Annuals; leaves often petiolate, thin and flattened; flowers restricted to terminal leafy spikes or spaced along the branches; fruiting calyx wings 0.4-1 mm long, to 1.5 mm broad 1. *K. scoparia*
- A. Perennials; leaves sessile, terete or essentially flattened; branches potentially floriferous throughout; fruiting calyx wings 1.3-2.5 mm long, 2.5-4 mm broad.
- B. Plants paniculately branched throughout, the pubescence brownish (at least on herbarium specimens); leaves more or less flattened (only slightly fleshy), 1.25-3.25 mm broad 2. *K. californica*
- B. Branching restricted to the base, the branches ascending, frequently simple; pubescence white or grayish or virtually lacking; leaves terete or subterete, 0.5-1.25 mm broad 3. *K. americana*

1. *KOCHIA SCOPARIA* (L.) Schrader, Neues Journal für die Botanik 3(3): 85. 1809.

Chenopodium scoparia L., Sp. Pl. 1: 221. 1753.

Kochia alata Bates, Amer. Bot. 24: 52. 1918. (Type: Bates 6767 US !).

Glabrous to puberulent or villous, branching annual, often turning red in Fall. Leaves petiolate to subsessile, lanceolate or oblanceolate to linear, 3-70 mm long, 0.5-7.5 mm broad, thin and flattened, not at all fleshy. Flowers sessile, in short, leafy spikes or spaced along the branches; anthers 0.5-1 mm long; calyx 1-2 mm long, the lobes 0.5-1.5 mm broad, in fruit developing membranous wings 0.4-1 mm long and up to 1.5 mm broad. Seed 1-1.8 mm broad.

Kochia scoparia, introduced from Europe as an ornamental, has escaped from cultivation in the United States, becoming naturalized in a number of localities. It could be expected to occur anywhere in the United States as a weed along roadsides or in waste places except in the Southeast. It has doubtless been cultivated for its red foliage, hence the name "fire-bush" or "burning-bush."

Variation is extensive in *K. scoparia* and has led to the proliferation of both species and varietal names. In attempting to account for the variation of *K. scoparia* in Missouri, Steyermark (1963) recognized three varieties: var. *culta* Farw., with thread-like leaves; var. *pubescens* Fenzl, with broader leaves and downy stems; and var. *scoparia*, with broader leaves and sparsely hairy to glabrous stems. We have encountered these and other "forms" of *K. scoparia* in our examination of specimens, but we find the variation to be essentially continuous and distinct geographical patterns

lacking. We do not see the necessity or even the advisability of formalizing the variation encountered in North America with infraspecific Latin epithets.

2. *KOCHIA CALIFORNICA* S. Watson, Proc. Amer. Acad. Arts 17: 378. 1882.
K. americana var. *californica* M. E. Jones, Contr. W. Bot. 11: 19. 1903.

Brownish, sericeous perennial from a woody base, paniculately branched throughout, the branches spreading or ascending, often striated. Leaves sessile, flat or somewhat fleshy, 2.5–17 mm long, 1.25–3.25 mm broad, densely hispid or sericeous, the apex more or less acute. Flowers axillary, solitary or in clusters of 2–5, often tomentose; anthers 0.5–1 mm long; calyx 1–2 mm long, the lobes 0.5–1.3 mm broad, becoming winged in fruit, the wings 2–2.5 mm long and 2.5–3 mm broad. Utricle pubescent, the seed ca. 2 mm in diameter.

TYPIFICATION: In connection with his original description, Watson (1882) cited two collections without preference: *Parry* [275], “near Colton;” and *Parish* [1348], “at Rabbit Springs, San Bernardino County.” By citing the type locality as “Near Colton,” Standley (1916) in effect preferred the *Parry* collection as lectotypic. Whether or not Standley meant to make this choice is nomenclaturally irrelevant. Regardless, we have found no reason to overturn his lectotypification. Since duplicates of *Parry* 275 exist in at least two herbaria (GH, F 134932), and since neither Standley nor anyone else has selected one as the lectotype, it would seem appropriate to do so herein. The Field Museum specimen is a mixed collection, *Parish* 1348 (F 134882) occupying the left side of the sheet and a fragment of *Parry* 275 the right. Although bearing the same collection number as the Gray Herbarium specimen, the label of the *Parry* collection reads “Mojave, California,” rather than Colton. On the other hand, the Gray Herbarium specimen of *Parry* 275 is more ample (two good branches on the sheet), it is not a mixed collection, and the label clearly states “Colton.” Thus, the Gray Herbarium specimen seems preferable as the lectotype, and we so designate it. It is moot to nomenclatural considerations that Colton may in fact be an erroneous locality. Mojave is more likely the actual collection cite since Colton is cismontane. It is interesting, and puzzling, that *Parry* 275 is the only collection, among all the *K. californica* specimens we examined, found to be in the fruiting condition, although a number of flowering specimens have been collected.

DISTRIBUTION: *Kochia californica*, more restricted in its distribution than the other native species, *K. americana*, appears to be limited to southeastern California and adjacent southwestern Nevada. The localized distribution, coupled with the dearth of fruiting specimens, led us initially to suspect that it was an introduced species, perhaps persisting locally, but not setting seed. Australia was considered as a possible source of introduction. However, our study of Australian and Old World *Kochia* specimens revealed no other species closely similar to *K. californica*. Dr. Paul G. Wilson of the Western Australian Herbarium, who has recently completed a manuscript

on *Kochia* in Australia, was kind enough to confirm our judgment in this matter based on color transparencies of herbarium specimens of *K. californica*, which we supplied him. Our appreciation is extended to Dr. Wilson for his assistance in the solution of this problem. We can only continue to conclude that *K. californica* is a native to North America, and that it does not occur elsewhere.

SPECIMENS EXAMINED (At least one specimen from each county recorded in our study is cited): CALIFORNIA: Fresno Co.: 9 mi S of Kerman, *Hoover* 2325 (US); alkaline plains, 2.5 mi E of Tranquility Junction, along California hwy. 180, *Bacigalupi, Wiggins* and *Ferris* 2670 (GH, UC). Inyo Co.: Shoshone, *Grinnell* s.n. (UC). Kern Co.: near Bakersfield, *Rogers* s.n. (UC); Rio Bravo, Buena Vista Lake, *Short* 288 (UC). Los Angeles Co.: Lancaster, Antelope Valley, *Abrams* and *McGregor* 509 (GH, US); Lancaster, *Elmer* 3717 (F, MO, US); uncultivated alkaline area 5 mi W of Lancaster on Antelope Valley Road, *Ferris* and *Rosbach* 9475 (F, UC). Madera Co.: 4 mi SW of Chowchilla, *Hoover* 2567 (UC, US); 16 mi from Madera on Firebaugh Road, *Hoover* 2619 (UC, US); San Joaquin Valley, *Kennedy* s.n. (UC). San Bernardino Co.: 3.5 mi SE of 15 Mile Pt., *Avetrod* 347 (UC); dry lake bed, Rabbit Springs, Mojave Desert, *Jepson* 5938 (UC); Victor, *Jones* s.n. (MU); Barstow, *Jones* 387 (GH); Victor, *Palmer* 224 (US); sandy arid hillside of Victorville, Mojave Desert, *Wheeler* 2077 (UC); Desert Wells, Mojave Desert, *Purpus* 5731 (UC, US). NEVADA: Nye Co.: 0.5 mi E of house on Ash Meadow Ranch, *Corville* and *Fumston* 369 (US).

3. *KOCHIA AMERICANA* S. Watson, Proc. Amer. Acad. Arts 9: 93. 1874.

K. americana var. *vestita* Watson, loc. cit.

K. vestita (Watson) Rydberg, Flora of Colorado 119. 1906.

Glabrate to gray-white hispid or sericeous perennial with more or less erect and often simple branches originating at or near the woody base, the branches frequently stramineous. Leaves fleshy, terete or subterete, 4–25 mm long, 0.5–1.25 mm broad, sessile. Flowers axillary, solitary or in groups of 2 or 3, often pubescent; anthers 1–1.5 mm long; calyx 2–2.5 mm long, the ovate lobes 1.3–2 mm broad, crenately winged in fruit, the mature membranous wings 1.3–2.5 mm long and 2.5–4 mm broad. Utricle glabrate to villous, the seed 1–1.8 mm broad.

TYPIFICATION: Watson (1874), in his protologue, cites the following collections: *Torrey* 465, *Watson* 992, *Green* s.n., and *Wheeler* s.n. These should be regarded as syntypic collections. As in the case of *K. californica*, Standley (1916) effected lectotypification of *K. americana* by citing "Western Nevada" as the type locality. Only the *Torrey* collection (from Humboldt Mountains, Nevada) fits this locality, and since the only specimen of *Torrey* 465 we have been able to locate is at the Gray Herbarium, we accept it as lectotype of the name *K. americana* var. *americana*. Unfortunately, it occurs on the same herbarium sheet with *Watson* 992, *Wheeler* s.n., and an additional specimen collected by Parry (*Parry* 260). However, this should not preclude its service as lectotype.

Following his description of *K. americana* var. *vestita*, Watson listed two specimens: *Watson* 991 and *Burgess* s.n. When Rydberg (1906) elevated variety *vestita* to a species, he did not specify a type. Once again we must look to Standley who, by indicating the type locality as "Shores of Great Salt Lake, Utah," was wittingly or unwittingly choosing a lectotype collec-

tion, *Watson 991*. The *Burgess* collection is probably from Nevada. We have seen the U.S. National Herbarium specimen of *Watson 991* (US 63408) and designate it as lectotype of the name *Kochia americana* var. *vestita* (isolectotype GH, but mixed with the *Burgess* collection).

The type of var. *vestita* is merely one of many variably pubescent individuals of *K. americana* we have seen, the variation being essentially continuous. We do not believe that this random variation in pubescence should be accorded varietal status, much less that of a species.

DISTRIBUTION AND SYSTEMATIC CONSIDERATIONS: *Kochia americana*, known as green-molly or gray-molly, has a much broader distribution than *K. californica*. According to our herbarium studies, *K. americana* ranges from southwestern Wyoming, southwestern Idaho, and southeastern Oregon, through Utah and Nevada, to southeastern California, northeastern Arizona, western Colorado, and southern New Mexico. Unlike *K. californica*, fruiting specimens of *K. americana* are frequent throughout its range.

Prior to *Watson's* description of *K. americana*, specimens in American herbaria were usually identified as *K. prostrata* Schrader, a broadly distributed Eurasian species. This, for example, was the case with *Watson 991* (the type of var. *vestita*). It remains to be finally demonstrated just how distinct *K. americana* and *K. prostrata* are. *Watson* (1874) suggests the following rather technical characters for separation: the pubescence of the utricle, the amount of albumin, and the prolongation of the radicle sheath. Dr. Paul G. Wilson of Australia has agreed that *K. americana* and *K. prostrata* are similar, but has declined to pronounce on their synonymy in the absence of more information about *K. prostrata*. Though *K. americana* and *K. prostrata* are unquestionably similar, we believe them to be distinct species based on habit, geographical distribution, and the characters discussed by *Watson*.

SPECIMENS EXAMINED (At least one specimen from each county recorded in our study is cited): ARIZONA: Apache Co.: 9 mi NE of Rock Point, *Peebles* and *Smith 13539* (US). Navajo Co.: near Agathla, *Eastwood* and *Howell 6634* (US). CALIFORNIA: Inyo Co.: Death Valley, Darwin Mesa, on road from Kieler to Darwin, *Coville* and *Funston 905* (GH, MO, US); open dry flats of hwy. 190, 5 mi E of road to Darwin, *Muntz 11739* (UT); Death Valley region, W side of Funeral Range, Boundary Canyon, *Wolf 6661* (GH). Lassen Co.: Honey Lake Valley, *Davy 3329* (UC). San Bernardino Co.: Barstow, *Brandegge* (UC). COLORADO: Mesa Co.: Gunnison watershed, Grand Junction, *Baker 928* (GH, MO, UC); Colorado National Monument, 3 mi S of Fruita, W of hwy. approach to monument, *Weber 3770* (TEX, UC). IDAHO: Owyhee Co.: Sinkers Creek, Idaho Range I. West, Township 3 South, *Davis 2113* (F). NEVADA: Churchill Co.: Fallon, *Tidestrom 10771* (F). Elko Co.: Battle Mts., *Kennedy 3078* (MO). Esmeralda Co.: Pinyon Hill, *Duran 2867* (UC); 1 mi N of Goldfield along Tonopah hwy., *Train 3441* (UC). Humboldt Co.: Humboldt Lake, *Jones 4057* (MO, UC, US); greasewood desert 30 mi W of Battle Mountain, *Bassett, Ruth,* and *C.B. Maguire 5871* (GH). Lander Co.: mouth of Birch Creek Canyon, 14 mi from Austin, *Henning 78* (F, MO, UC); Eastgate, *Train s.n.* (MU). Lincoln Co.: Cathe-

dral Gorge State Park, 3 mi NW of Panaca, *Train* 2480 (UT). Lyon Co.: 6 mi SE of Rockland, Wellington, *Hendrix* 644 (UC). Mineral Co.: near reservoir at head of Pickhandle Gulch, *Ferris* 13106 (GH, UC); 2 mi S-SW of Sonoma, Bridgeport, *Graham* 281 (UC). Nye Co.: 2 mi NW of Penelas Mill, 15 mi NW of Ione, *Beach* 818 (UC, US); 2 mi below mouth of the north fork of Twin Rivers, *Henning* 100 (UC). Washoe Co.: 20 mi E of Reno, *Archer* 6231 (F, MO, UC); northern base of Granite Range, 1.5 mi NE of Gerlach, *Bacigalupi* 5917 (UC). White Pine Co.: 26 mi SW of Ely, *Davis* D2619 (UT). NEW MEXICO: Dona Ana Co.: Mesquite, roadside, Lower Sonoran Zone, *Fosberg* S3452 (GH). OREGON: Harney Co.: Island Ranch, near Burns, *Griffiths* and *Morris* 720 (MO); Narrows, *Peck* 1657 (GH). Malheur Co.: forks of Malheur, *Cusick* 1111 (US). UTAH: Box Elder Co.: *Garrett* 5389 (F, UT). Emery Co.: hillsides of East Ferron, *Cottam* 5200 (UT). Juab Co.: 3 mi W of Trout Creek, *Maguire* and *Becraft* 2574 (MO). Millard Co.: Painter Spring, *Fautin* 8931 (F); Milford, *Jones* 1491 (A, F, US). Piute Co.: along Sevier River, *Rydberg* and *Carlton* 6929 (US). Salt Lake Co.: near Garfield, *Flowers* 952 (UT). San Juan Co.: 0.5 mi E of Mounts and Jaques Trading Post, 3 or 4 mi W of Hovenweep National Monument, *Cutler* 2757 (GH, MO). Sevier Co.: Glenwood, *Ward* 154 (MO, US). Tooele Co.: Stansbury Island, Great Salt Lake, *Garrett* 5357 (F); W of Grantsville, *Harris* C2056 (MO). Utah Co.: near railroad track between Bringham and Lehi, *Garrett* 5206 (F, UT). Uintah Co.: desert SE of Jensen, *Graham* 8297 (F). Washington Co.: Valley of Virgin, near St. George, *Parry* 224 (GH, MO, US). Wayne Co.: Blue Valley, *Stanton* 515 (UT). WYOMING: Carbon Co.: Fort Steele, *Tweedy* 4496 (US). Sublette Co.: plains between Eden and Big Piney, *E. and L. Payson* 2590 (MO, UC). Sweetwater Co.: Rock Springs, *Degener* and *Reiler* 16101 (MO); Point of Rocks, *Merrill* and *Wilcox* 649 (GH, US). Uinta Co.: near Hampton, *Patterson* and *Beatty* s.n. (F).

REFERENCES

- AIRY SHAW, H. K. 1973. J. C. Willis: A Dictionary of the Flowering Plants and Ferns, 8th edition. Cambridge University Press, London.
- BALL, P. W. in T. G. TUTIN *et al.* 1964. *Koebia* in Flora Europaea 1: 98-99.
- DAVIS, R. J. 1952. Flora of Idaho. Brigham Young University Press, Provo, Utah.
- ROTH, W. A. 1800. *Koebia*. Journal für die Botanik 1: 306-308.
- RYDBERG, P. A. 1906. Flora of Colorado. Bulletin of the Colorado Agricultural Experiment Station 100.
- STANDLEY, P. C. 1916. Chenopodiaceae in North American Flora 21(1): 3-93.
- STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames.
- WATSON, S. 1874. A revision of the North American Chenopodiaceae. Proc. Amer. Acad. Arts 9: 82-126.
- . 1882. Contributions of American botany. Lists of plants from southwestern Texas and northern Mexico, collected chiefly by Dr. E. Palmer in 1879-80. loc. cit. 17: 316-361.
- WEBER, W. 1972. Rocky Mountain Flora. University of Colorado Press, Boulder.